Determining Entrance and Safety Dike Pipe Culvert Lengths

Design Manual
Chapter 4
Drainage
Originally Issued: 01-23-04

This section covers the proper determination of pipe length and payment for entrance and safety dike pipe culverts. Typically, entrances or safety dikes with pipes will have foreslopes of 8:1. In cases where a steep ditch grade, 4% or more, is involved the designer may want to adjust the foreslopes. Section 3F-3 of this Manual discusses transverse foreslope adjustments.

The minimum pipe size that should be considered for new entrances is 18 inches (450 millimeters). Replacement pipes for reconstructed entrances should be the same size as existing pipes unless conditions have changed or there is knowledge the current pipe is too small. A minimum of 1 foot (0.3 meters) of cover should be placed over the pipe. If this is difficult to achieve, the pipe may be buried up to 6 inches (150 millimeters) without significant loss of capacity.

Selecting and Specifying an Entrance or Safety Dike Pipe Culvert

In order to ensure uniform methods in determining lengths for entrance or safety dike pipe culverts, the following procedure should be used:

1. A cross-section of the entrance or safety dike, including the entrance or safety dike pipe with apron, should be plotted on the detail cross-sections. This cross-section should be plotted as seen from the roadway and should be drawn to the normal cross-section scale.
2. The cross-section should show the top width (W), foreslope at the pipe, depth of fill at the centerline over the pipe (H), and the pipe with aprons. The dimensions left and right of the entrance or safety dike centerline should also be given. These dimensions can be determined in CADD.
3. The entrance or safety dike profile should be shown both on the cross-sections and plan and profile sheet. The pipe should be of adequate size to handle drainage, and should be a minimum of 18 inches (450 millimeters) in diameter.
4. Pipe lengths should be determined using measurement tools in CADD. Pipe length is measured to the nearest foot (0.1 meters) between the intercepts of the top of the pipe with the foreslopes (see Figure 1). Pipe lengths should be determined assuming a CMP Pipe (see Road Design Details 1601, 1602, and 1603). Pipe lengths will need to be adjusted when concrete pipes are specified (see Example 2).

Payment Length

The values obtained using Figure 1 provide pipe lengths excluding aprons (Standard Road Plans RF-3 and RF-5 provide more information regarding aprons). This length shall be used as payment length. If concrete pipes are specified, pipe and payment length are slightly reduced by subtracting two times the distance “C” determined in Standard Road Plan RF-3 from the value obtained for the pipe length. Since concrete pipes are typically provided in two-foot (0.5-meter) lengths, this new value is then rounded up to the nearest two-foot increment (or nearest 0.5 meters).

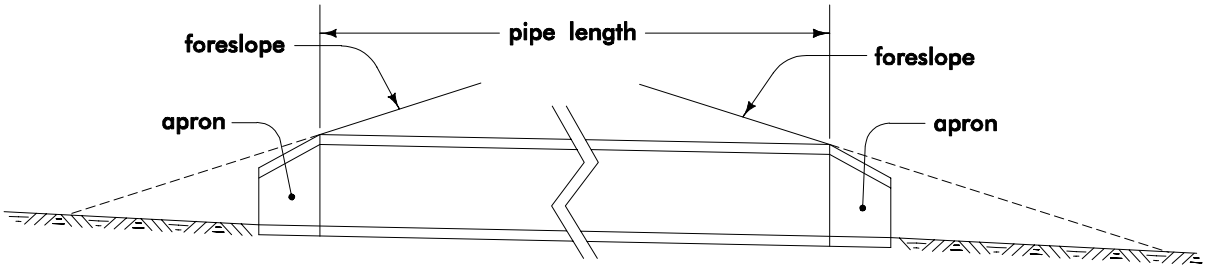

Figure 1: Determining pipe length in CADD. Note: pipe length will require adjustment if concrete pipe is specified, see Example 2.

Example 1

A 30-foot (9-meter) entrance requires an 18-inch (450-millimeter) unclassified pipe which has 9 feet (3 meters) of fill over the top of the pipe and an entrance foreslope at the pipe of 8:1 (see Figure 2). Determine the pipe and payment length if the ditch grade through the entrance is 2%.

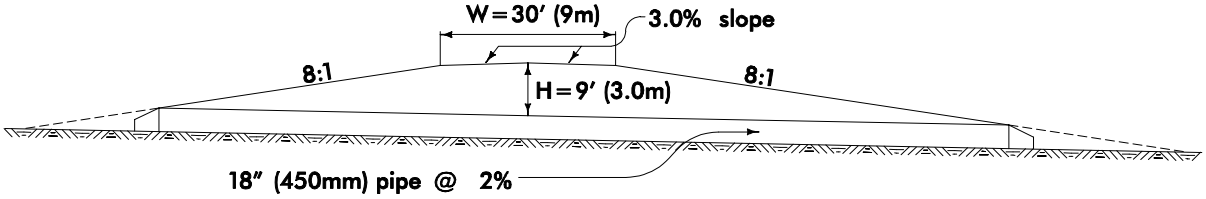

Figure 2: Cross-section of entrance for Example 1.

Using CADD and assuming the pipe is CMP, the pipe length is determined to be 171 feet (56.3 meters). Since this pipe is not specified as a concrete pipe, no adjustment is made for aprons; therefore, pipe and payment length are 171 feet (56.3 meters).

Example 2

A 24-inch (600-millimeter) concrete pipe is being placed under a 36-foot entrance. Six feet (1.8 meters) of fill will be placed over the top (see Figure 3). The ditch grade is 6.5%. Determine the pipe length required and the payment length if Type 1 aprons are to be used.

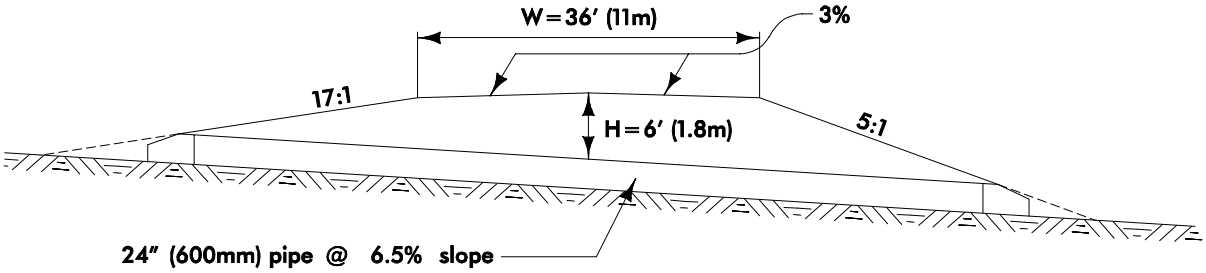

Figure 3: Cross-section of entrance for Example 2.

Since the ditch grade is 6.5% the foreslopes have been adjusted to 17:1 upstream and 5:1 downstream (see Section 3F-3). Using CADD the pipe length is determined to be 120 feet (36.2 meters). Since this will be a concrete pipe, refer to Standard Road Plan RF-3 to obtain a value for "C". For a Type 1 apron, this value is 2'-6" (760 millimeters). First, twice this value is subtracted from the value obtained above:

120 ft. – (2 x 2.5 ft.) = 115 ft. 36.2 m – (2 × 0.76 m) = 39.28 m

Rounding up to the nearest 2-foot (0.5-meter) increment, pipe and payment length are then 116 feet (39.5 meters).